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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
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| 10/577,540 | 09/25/2006 | Edward J. Anthony | SHAP:1001RCE | 9837 |
| 34725 CHALKER FLORES, LLP 2711 LBJ FRWY Suite 1036 DALLAS, TX 75234 | 7590 10/01/2010 | | | |
| EXAMINER | | | | |
| LIAO, DIANA J | | | | |
| ART UNIT | | PAPER NUMBER | | |
| 1793 | | | | |
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary

Application No.

10/577,540

Applicant(s)

ANTHONY ET AL.

Examiner

DIANA J. LIAO

Art Unit

1793

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 14 July 2010.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 21-29 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 21-29 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO/SB/CD)
Paper No(s)/Mail Date 7/14/2010
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date _____
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: _____

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after allowance or after an Office action under *Ex Parte Quayle*, 25 USPQ 74, 453 O.G. 213 (Comm'r Pat. 1935). Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, prosecution in this application has been reopened pursuant to 37 CFR 1.114. Applicant's submission filed on 7/14/2010 has been entered.

Information Disclosure Statement

2. The information disclosure statement (IDS) submitted on 7/14/10 is in compliance with the provisions of 37 CFR 1.97. Accordingly, the information disclosure statement is being considered by the examiner.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

5. Claims 21-29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Shimizu, et al. ("A Twin Fluid Bed Reactor..." 1999) in view of Kuramoto, et al. ("Repetitive Carbonation – Calcination Reactions of Ca-Based Sorbents..." 2003)

Shimizu, et al. teaches a process for CO₂ removal using calcium oxide. The process uses two fluidized bed reactors, one absorber and one regenerator. CaO captures CO₂ in the absorber to form CaCO₃, which is then transported to the regenerator to recover CaO. The CaO recovered is recycled back into the absorber, creating a cyclic process. The flue gas from the regenerator is high purity CO₂ of greater than 95% on a dry base. The calcium carbonate is calcined at 1223K (or 950°C) in the regenerator, equivalent to claimed calcining step. (see abstract and figure 1) The process may be done at atmospheric pressure. (pg 62)

Regarding the use of lime and carbonating to create limestone, this is considered to be inherent or obvious in view of Shimizu, et al. Lime and limestone are generally accepted to be represented by the formulas CaO and CaCO₃ respectively. Thus exchanging the two terms would not appear to define a different process. In the event that lime and limestone have a different meaning than CaO and CaCO₃ as recited by

Shimizu, et al., it would have been obvious to use lime and limestone since they are naturally found abundant minerals which can capture CO₂.

Regarding the selective removal of carbon dioxide, it would have been obvious to recover any materials in an industrial process. The carbon dioxide stream taken from the regeneration step is of very high purity, and one of ordinary skill in the art would have been motivated to capture the carbon dioxide for either sale or disposal. Releasing excess greenhouse gases such as carbon dioxide would be environmentally undesirable. The carbon dioxide and the gas stream in general would have to be recovered for further processing.

Regarding the type of fluidized beds employed, they are found obvious in view of Shimizu, et al. Shimizu, et al. generically teaches fluidized beds, and fairly teaches the species of pressurized or circulating fluidized beds. Pressurized fluidized beds are known in the art for their added advantage of high pressure exhaust gasses or steam which may be used for turbines. Circulating fluidized beds have the advantage of reintroducing particles back into the main reactor several times which is advantageous because the process is overall more efficient by cycling the particles through the reactor to reach full conversion. One of ordinary skill in the art would have been motivated to use the process as taught in Shimizu, et al. and apply it to any suitable fluidized bed scheme.

Shimizu, et al. does not teach a process including the hydration of an alkaline earth metal oxide prior to carbonation. Shimizu, et al. also does not specifically teach a process at an elevated pressure.

Kuramoto, et al teaches that Ca-based sorbents are significantly deactivated from high temperature calcination treatments. Kuramoto, et al. also teaches that an intermediate hydration step appears to enhance the reactivity and durability of the sorbents which are used for multiple cycles. (abstract) The hydration step occurs in between the calcination and carbonation steps. (pg 977) The hydration step may be performed at 873K under high pressure in a vapor phase, with desirable results outperforming a calcium sorbent undergoing repetitive calcination and carbonation without intermediate hydration. (Figure 5 and description) The hydration treatment was tested at both atmospheric and pressurized environments. (pg 977) Hydration treatment is advantageous at both pressures. (Fig 4 and Fig 5)

One of ordinary skill in the art would have been motivated to perform the intermediate hydration step as taught in Kuramoto, et al. using water vapor at above 50°C in the cyclic process taught in Shimizu, et al, in order to achieve the increased sorption capacity and durability taught in Kuramoto, et al. Shimizu, et al. teaches that the sorbents are reused after capturing carbon dioxide and are calcined in the regeneration process at a temperature which is taught in Kuramoto, et al. to deactivate the sorbents over time. The hydration step would mitigate such deactivation.

Regarding performing the process at greater than atmospheric pressure, Kuramoto, et al. teaches that either pressure is suitable for cyclic carbonation processes and thus they are obvious variants from one another which would depend on the needs and capabilities of the process and apparatus. In addition, comparing Figures 4 and 5, one of ordinary skill in the art would appreciate that given that an intermediate hydration step is utilized, that a greater $X_{CO_2/CaO}$ is achieved at higher pressure compared to any of the other sorbents tested. Thus one of ordinary skill in the art would have been motivated to use a pressure higher than atmospheric pressure.

Regarding using liquid water or steam at above 50°C and also at atmospheric pressure, Kuramoto, et al. does not specifically teach that combination. However, since the hydration step is found to be advantageous at both atmospheric pressure and room temperature in liquid form, and also at a higher pressure at an elevated temperature in the vapor phase, one of ordinary skill in the art would have a reasonable expectation of success to perform the hydration at both an elevated temperature and atmospheric pressure and still achieve the same results. One would be motivated to do so if pressurized reactors were not available or required excess monitoring. Since the rest of the calcination and carbonation occurs in a gaseous phase, it would have been obvious to use a steam as opposed to liquid water in the hydration step, and the temperature would have to be elevated to at least 100°C in order to do so.

Therefore, due to the motivation to decrease sorbent deactivation, claims 21-29 are not found patentable over the prior art.

6. Claims 21-29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kuramoto, et al in view of Shimizu, et al.

Kuramoto, et al. teaches the repetitive carbonation-calcination process as discussed above, with an intermediate hydration step between calcination and carbonation. The pressurized trials utilize water vapor at above 50°C for the hydration step. The calcination steps in the study were conducted at 1173K, which is in the claimed range. Hydration was performed in both atmospheric and pressurized environments as denoted by a-CHC and p-CHC. (pg 977) Limitations regarding the pressure and temperature of the steps are discussed above.

Regarding the use of lime and carbonating to create limestone, this is considered to be inherent or obvious in view of the prior art. Lime and limestone are generally accepted to be represented by the formulas CaO and CaCO_3 respectively. Thus exchanging the two terms would not appear to define a different process. In the event that lime and limestone have a different meaning than CaO and CaCO_3 , it would have been obvious to use lime and limestone since they are naturally found abundant minerals which can capture CO_2 .

Kuramoto, et al. does not teach that the process is performed in a fluidized bed. Kuramoto, et al. also does not teach that the carbon dioxide is selectively removed.

Shimizu, et al. teaches a cyclic sorbing process involving reusing a calcium oxide sorbent to sequester carbon dioxide and its regeneration as discussed above. Shimizu, et al. utilizes a fluidized bed.

Regarding the selective removal of carbon dioxide, it would have been obvious to recover any materials in an industrial process. The carbon dioxide stream taken from the regeneration step is of very high purity, and one of ordinary skill in the art would have been motivated to capture the carbon dioxide for either sale or disposal. Releasing excess greenhouse gases such as carbon dioxide would be environmentally undesirable. The carbon dioxide and the gas stream in general would have to be recovered for further processing.

Regarding the type of fluidized bed, the reasoning as discussed in the above rejection applies. It would have been obvious to perform this process using any suitable fluidized bed.

One of ordinary skill in the art would have been motivated to utilize the industrial process schemes of Shimizu, et al. with the laboratory process of Kuramoto, et al. in order to make the process more commercially viable.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to DIANA J. LIAO whose telephone number is (571)270-

3592. The examiner can normally be reached on Monday - Friday 9:30am to 6:00pm EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Stanley Silverman can be reached on 571-272-1358. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Ngoc-Yen M. Nguyen/
Primary Examiner, Art Unit 1793

DJL